OTTO VON GUERICKE
UNIVERSITÄT
MAGDEBURG

MED

MEDIZINISCHE
FAKULTÄT

Forschungsbericht 2020

Dekanat

DEKANAT

Otto-von-Guericke-Universität Magdeburg
Medizinische Fakultät
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1. LEITUNG

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2. FORSCHUNGSPROJEKTE

Projektleitung: Prof. Dr. Michael Friebe
Kooperationen: ExoExecute, Canada, Ken Merkel
Förderer: Industrie - 18.12.2020 - 05.06.2021

SciFi HIVE Future of Health

We conduct a global 4 hour workshop on the future of health, future of hospital, future of homeware, and other related topics. 100 selected attendees will be part of that novel process with the result of creating a SciFi comic story.

Projektleitung: Dr.-Ing. Axel Boese, Prof. Dr. Michael Friebe
Kooperationen: Olympus, Hamburg
Förderer: Industrie - 01.01.2020 - 30.06.2021

Endovascular Endoscopy with OCT

Development of a joint OCT and end-vascular system for the detection of vascular defects in just one acquisition. For that we designed a system that can be used in the normal blood carrying vessels. The imaging field of view is cleared through a flushing possibility.

Projektleitung: Prof. Dr. Michael Friebe
Projektbearbeitung: M.Sc. Jens Ziegle, Dr.-Ing. Axel Boese
Kooperationen: ACMIT Wiener Neustadt
Förderer: Industrie - 01.04.2017 - 30.04.2020

Tomographic 3D Ultrasound for Safe and More Cost Effective Vascular Diagnostics and Treatment Planning

Annually, cardiovascular disease (CVD) causes over 4m deaths in Europe and 17.3m deaths globally, and is expected to grow to over 23.6m by 2030. It accounts for 40% of deaths in the EU and costs the EU economy almost 196bn each year. 2D ultrasound scans are currently the primary choice for vascular diagnostics. Due to low sensitivity, a limited field of action and the lack of volume information, patients are often referred for CTa, MRa and catheter angiography for the detailed imaging required for diagnosis and treatment planning. Referrals delay treatment, exposes the patient to risks associated with radiation and contrast mediums and increases costs. This presents a need to improve the speed and safety of the diagnosis of vascular conditions for rapid treatment, as well as to improve workflow efficiency and reduce costs. The project consortium will further develop the piur tUS system, a 3D freehand tomographic US system capable of rapid, safe and accurate reconstructive 3D quantifiable vascular imaging. It will provide a low cost and reproducible imaging solution that will reduce the need for referrals and be an effective preventative screening tool for CVD. We aim to complete and publish the results from 4 CVD clinical studies to generate the clinical evidence required for CE marking and clinical validation for market uptake. The 4 clinical applications studied will provide a solution for conditions most frequently referred for detailed 3D imaging to maximise the cost-benefit to clinics of purchasing the piur tUS system. The project consortium combines piur imaging's expertise in medical device development and commercialisation with 3D imaging specialist ImFusion GmbH and medical device product development and manufacturing experts ACMIT. The clinical input for the product development and the clinical studies will be provided by our consortium partners, Independent Vascular Services Ltd and the Institute for Cardiovascular Science: University of Manchester. The INKA chair, institute for medical technologies, OvGU in Magdeburg provides innovative solutions for tracking the 2D ultrasound images.

Projektleitung:	Dr. Alfredo Illanes, Prof. Dr. Michael Friebe
Kooperationen:	Universitätsklinik für Allgemein-, Viszeral-, Gefäß- und Transplantationschirurgie (KCHI), Prof. Dr. med. Croner; Intuitive Surgical
Förderer:	BMWi/AIF - 01.01.2020 - 31.12.2022

Surgical Audio Guidance for Robotic Assisted Surgeries

Continuous work as part of the SURAG (Surgical Audio Guidance) EXIST-Forschungstransfer on listening to tissue-tool interactions during Robotic Assisted Surgery to detect vascular structures and to be able to characterise tissue/organ surfaces for a simulated palpation sense.

Projektleitung:	Dr.-Ing. Axel Boese, Prof. Dr. Michael Friebe, Prof. Dr. Christoph Arens, MSc. Naila Esmaeili
Kooperationen:	OVGU Magdeburg, Universitätsklinik für Hals-, Nasen- und Ohrenheilkunde, Kopf- und Halschirurgie (KHNO); Olympus: RFA, Resectoscope, Endoscopy
Förderer:	Industrie - 01.01.2020 - 31.03.2021

AI based detection of lesions during contact endoscopy of the Larynx

Video sequences of the larynx during contact endoscopy are analysed based on the vascular structure that indicate different stages in the development of cancer. We use a novel approach and algorithm to classify the structures.

Projektleitung: MSc. Holger Fritzsche, Prof. Dr. Michael Friebe
Kooperationen: Siemens Healthineers, Innovation Think Tank, Prof. Haider
Förderer: Industrie - 18.12.2020 - 31.12.2024

INNOVATION THINK TANK - Siemens Healthineers

We have been certified as a SIEMENS HEALTHINEERS INNOVATION THINK TANK offering healthcare innovation programs and being part of the global network of think tanks. Together with partners from HEALTHINEERS we are addressing workflow and dedicated innovation needs and supervise graduate and doctoral students.

Projektleitung: Prof. Dr. Michael Friebe
Projektbearbeitung: Dr.-Ing. Axel Boese, Markus Weinreich
Kooperationen: VISUS Industry IT GmbH
Förderer: BMWi/AIF - 01.05.2018 - 30.04.2020

Image Quality Assessment in der zerstörungsfreien Werkstoffprüfung

Material testers using high-energy electromagnetic radiation for radiographic examinations in non-destructive testing. They irradiate objects like pipes with welds to expose radiographic films to examine for example the thickness of the pipes, the appearance of rust or cracks in the material. These exposured films have to meet certain standards like optical density and resolution, that are, inter alia, depending on the exposure time. Usually a material tester uses tables to get aproxximate times for different setups (materials, X-ray or gamma sources). With the help of CMOS image sensors, we are creating an embedded system to measure and capture the dose of radiation of an X-ray or gamma source behind the objects to be examined, in order to specify the exposure times of the radiographic films.

Projektleitung: MSc. Moritz Spiller, Prof. Dr. Michael Friebe, M.Sc. Thomas Sühn
Förderer: Industrie - 18.12.2020 - 01.06.2021

Community-based Information System for HIV

Development of a community-based information system for an NGO in Namibia. Goal is to support HIV social programs in co-operation with the Society for family health organisations by providing them with a smartphone based tracking and communication system.

Projektleitung: MSc. Moritz Spiller, Prof. Dr. Michael Friebe, M.Sc. Thomas Sühn, MSc. Naila Esmaeili, MSc. Rutuja Salvi, Dr.-Ing. Axel Boese
Kooperationen: Brainlab AG; IDTM: MagRemon; Fraunhofer ISST; Universitätsklinikum Essen, Kardiologie
Förderer: Industrie - 01.09.2020 - 31.03.2022

Auscultation of Carotid Sounds

Development of an external device that measures the emitted sounds of flow, cardiac pulsation, heart valves, coughing, swallowing ... with the goal to segment and classify these sounds to create a personal profile.

Projektleitung: Dr. Alfredo Illanes, Prof. Dr. Michael Friebe
Kooperationen: AGH University Krakov, Biomedical Engineering
Förderer: Sonstige - 01.06.2020 - 31.05.2021

Needle Guidance through proximal Audio Emission and AI Classification

The main **purpose** of the project is to **increase the guidance accuracy in soft-tissue needle procedures,** to improve confidence in locating anatomical targets,and to reduce the false-negative rate of biopsy results.
In soft-tissue cancer, the initial diagnosis is often obtained by imaging systems (e.g. *Magnetic Resonance Imaging* - MRI). If tumorous tissues are indicated, a biopsy is performed to acquire tissue samples for histopathological examination. The biopsy is typically carried out by an experienced physician under control of an imaging system (e.g. *Ultrasound* - US) that shows the examined area as the samples are collected. *US guided prostate biopsy after MRI diagnosis* is a common example of such a procedure.
In this project, we decided to focus mainly on prostate biopsy, as one in seven men is diagnosed with prostate cancer in their lifetime. The initial diagnosis is typically done with a time-consuming MRI that provides images with good contrast between pathological and healthy tissue. The US imaging systems used for real-time guidance of the biopsy device is fast, but the image does not allow to discriminate the soft tissues inside the prostate. The physician needs to use a technique called cognitive biopsy: he has to mentally match the 3D MRI image acquired beforehand with the 2D US acquired in real time to guide the device to the targeted location. Despite the fact that 12 samples are typically taken, it is still possible to miss the tumor tissue due to the lack of proper registration between image modalities. With each subsequent puncture, the correlation between the MRI and US images decreases as a result of deformation and damage to soft tissues. This leads to false-negative histopathology results that hinder the therapy: the procedure needs to be repeated, and the treatment is delayed, decreasing the patient's chance of recovery. The false-negative rate of prostate biopsy varies from 17 to 21%, in patients with a negative first series of biopsies.

Projektleitung: Dr.-Ing. Axel Boese, Prof. Dr. Michael Friebe
Kooperationen: MR:comp GmbH, Gelsenkirchen; IDTM: easyJector
Förderer: Industrie - 01.12.2020 - 30.11.2021

EasyJector Contrast Media MRI Injector - II

Novel drive and release mechanism for a fully compatible MRI contrast media injector that focusses on simplicity and cost reduction while providing the needed injections with associated time savings. The project is continued through several Master projects.

Projektleitung: Dr. Ali Pashazadeh, Prof. Dr. Michael Friebe
Kooperationen: OVGU Magdeburg, Universitätsklinik für Strahlentherapie; ONCOBETA, Herr Vetter, München
Förderer: Industrie - 01.07.2020 - 31.12.2021

RADPRINT - towards a personalised (additively manufactured) radiation therapy for selected superficial tumors

Continued development of a 3D printing technology that uses imaging data to create a tutor volume, subsequently a radiation plan based on Y90 or other Beta-particles, and personalised patch creation. The project is based on a PhD thesis submitted and completed at our lab in 2020.

Projektleitung: Prof. Dr. Michael Friebe
Kooperationen: TU München - CAMP - Prof. Nassir Navab; Queensland Technical University, Brisbane, Australia - Prof. Dietmar Hutmacher; FRANKA EMIKA GmbH
Förderer: Industrie - 18.12.2020 - 31.12.2021

SURGITOMO a novel approach for a low-cost surgical Tomosynthesis system

Development concept for a novel approach to tackle the issue with needle / device guidance during surgeries. The concept would use low-cost X-ray sources with a relocatable model to create semi 3D-images with significantly reduced radiation for patient and clinician.

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Prof. Dr. Michael Friebe, M.Sc. Nazila Emaeili, M.Sc. Moritz Spiller, M.Sc. Thomas Sühn, Dr. Alfredo Illanes
Kooperationen: Prof. Roland Croner, OVGU FME KCHI; Prof. Patrick Schuler, KHNO Ulm; Prof. Christoph Arens, OVGU, FME, KHNO; Prof. Christoph Lohmann, OVGU, FME, KORT; Prof. Jessica Bertrand, OVGU, FME, Experimentelle Orthopädie
Förderer: BMWi/AIF - 01.03.2020 - 28.02.2022

SURAG Surgical Audio Guidance (INKA Healthtec Innolab @ UMMD)

Establish audio guidance as an easy add-on support for therapy device navigation, tissue characterization, low-cost hybrid imaging, implant sensoring, intravascular monitoring, and palpation/haptic sensation in robotic surgeries.

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Holger Fritzsche, Prof. Dr. Michael Friebe
Förderer: EU - EFRE Sachsen-Anhalt - 01.03.2019 - 31.12.2021

ego.-INKUBATOR "InnoLab IGT - Innovationslabor - Image Guided Therapy (INKA Healthtec Innolab @ UMMD)

Upcoming challenges in healthcare delivery and regional/global unmet clinical needs require new concepts for related purpose driven research and development to ensure a quick translation back to clinical use.
With the HealthTEC Innovation lab (INNOLAB:IGT) we have established an interdisciplinary development environment with close ties to several clinical users, international partners (Australia, India, Egypt, UK, Switzerland, Turkey, USA, Chile), and translation networks.
Our primary focus has been on workflow-, and device- innovation for image guided and minimal invasive therapies, as well as on novel health monitoring approaches.
We are able to IDENTIFY Unmet Clinical Needs, define problem statements and provide IDEAS/INVENTIONS, can validate the prototypes, and have shown to be able to work with partners on IMPLEMENTATION and TRANSLATION. With that approach we have generated over 40 patents, identified more than 100 needs and created just as many prototypes in the last 5 years.
For that we provide a fully equipped clinical development environment (diagnostic and minimal invasive therapy systems, robots, 3D printers, electronics / mechanical lab, comprehensive machine learning expertise) and empathetic and knowledgeable development staff.
Engineering students (biomedical, electrical, computer science, and mechanical) and clinical students learn to work in a focused and interdisciplinary innovation environment from identification all the way to a potential technology transfer with the clinical user and at the same time stimulate start-up activities in this area.
We also know the regulatory environment and the economic realities of bringing innovation to the clinical markets.
We look forward working with you!

Projektleitung: Dr.-Ing. Axel Boese
Kooperationen: Prof. Dr. med. habil. Uwe-Bernd Liehr, OVGU, FME, KURO; PD Dr. med. habil. Johann J. Wendler, OVGU, FME, KURO
Förderer: Stiftungen - Sonstige - 01.01.2020 - 31.12.2021

Nachweis der Bildung von Protoporphyrin IX (PPIX) in der Blase durch ein endoskopisches Fluoreszenz-Filtersystem zur Optimierung der Photodynamischen Diagnostik und Therapie (INKA Healthtec Innolab @ UMMD)

Die PDD ist ein etabliertes Verfahren bei der Blasenkrebsdiagnostik. Die Fluoreszenz der Tumorzellen soll eine schnellere und sichere Detektion ermöglichen. Allerdings ist die Verlässlichkeit des Verfahrens stark vom richtigen Diagnosezeitpunkt nach Gabe von Hexvix abhängig. Ziel ist es, mit einen neuen Messsystem (Fluoreszenz-Filtersystem) den Verlauf der Bildung der Precursor CPIII und UPIII und von PPIX aufzunehmen um daraus den optimalen Diagnosezeitpunkt abzuleiten.

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Prof. Dr. Michael Friebe, Dr. Alfredo Illanes, Nazila Esmaeili
Kooperationen: Prof. Christoph Arens, OVGU, FME, KHNO; Prof. Dr. Nassir Navab, TU München, CAMP
Förderer: Stiftungen - Sonstige - 01.01.2017 - 31.12.2022

Automatic Classification of Laryngeal Lesions based on Vascular Patterns in Contact Endoscopy (INKA Healthtec Innolab @ UMMD)

INKA Healthtec Innolab @ UMMD: Contact endoscopy (CE) is a minimally invasive procedure providing real-time information about the cellular and vascular structure of the superficial layer of laryngeal mucosa. This method can be combined with optical enhancement methods such as narrow band imaging (NBI). However, these techniques have some problems like subjective interpretation of vascular patterns and difficulty in differentiation between benign and malignant lesions. We propose a novel automated approach for vessel pattern characterization of larynx CE + NBI images in order to solve these problems.

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Prof. Dr. Michael Friebe, Dr. Alfredo Illanes, M.Sc. Elmer Ataide
Kooperationen: Prof. Dr. med.Michael Kreißl, OVGU, FME, KNUK; Dr. S. Schenke, OVGU, FME, KNUK
Förderer: Stiftungen - Sonstige - 01.01.2019 - 31.12.2021

Thyroid Nodule Classification for Physician Decision Support (INKA Healthtec Innolab @ UMMD)

The classification of thyroid nodules using ultrasound (US) imaging is done using the Thyroid Imaging Reporting and Data System (TIRADS) guidelines that classify nodules based on visual and textural characteristics. These are composition, shape, size, echogenicity, calcifications, margins, and vascularity. This work aims to reduce subjectivity in the current diagnostic process by using geometric and morphological (G-M) features that represent the visual characteristics of thyroid nodules to provide physicians with decision support. A total of 27 G-M features were extracted from images obtained from an open-access US thyroid nodule image database. 11 significant features in accordance with TIRADS were selected from this global feature set. Each feature was labeled (0 = benign and 1 = malignant) and the performance of the selected features was evaluated using machine learning (ML). G-M features together with ML resulted in the classification of thyroid nodules with a high accuracy, sensitivity and specificity. The results obtained here were compared against state-of the-art methods and perform significantly well in comparison. Furthermore, this method can act as a computer aided diagnostic (CAD) system for physicians by providing them with a validation of the TIRADS visual characteristics used for the classification of thyroid nodules in US images.

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Prof. Dr. Jessica Bertrand, Prof. Dr. Heike Walles, Prof. Dr. Michael Friebe
Förderer: Bund - 01.10.2020 - 31.03.2021

Konzeptphase MEDINET Industrie in Klinik Plattform (INKA Healthtec Innolab @ UMMD)

Das **MED Innovation Network (MEDINET)** soll durch seine Struktur Medizintechnikunternehmen helfen, die Chancen eines **erfolgreichen Markteintritts** und eine **nachhaltige Marktdurchdringung** zu erhöhen und den Kliniken in Sachsen-Anhalt **eine Qualitätsführerschaft** zu ermöglichen.
MEDINET vermittelt Expertise und Dienstleistungen entlang des gesamten Produktentstehungsprozesses. MEDINET wird getragen von der MEDICS GmbH als Beratungsdienstleister, dem INKA Innolab an der Universitätsmedizin Magdeburg (UMMD), medizinischen Experten, zertifizierten Laboren der Uniklinik, der Core Facility Tissue Engineering und weiteren Institutionen der Otto-von Guericke Universität Magdeburg (OVGU).

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Holger Fritzsche, Anna Schaufler, Prof. Dr. Michael Friebe
Förderer: EU - EFRE Sachsen-Anhalt - 01.10.2019 - 30.10.2022

OrthoBioSense -Orthopedic implants for assessing the individual biological response using sensors (INKA Healthtec Innolab @ UMMD)

Nichtinvasives Messkonzept für den Verschleis von künstlichen Gelenken

Orthopädische Implantate sollen mit Technologien ausgestattet werden, die den Verschleisszustand im Körper überwachen und dann extern - nach Möglichkeit vom Patienten selbst - auslesbar machen. Zur Lösung dieses Ansatzes sollen Sensoren entwickelt werden, die den Verschleiss einer Endoprothese einschätzen und die Implantatposition bewerten können. Der Patient wird dann diese Sensoren in bestimmten Abständen auslesen und dem Operateur übermitteln. So kann dann auch bei Auffälligkeiten ein schneller Vorstellungstermin vereinbart werden.

Projektleitung: Dr.-Ing. Axel Boese
Projektbearbeitung: Elmer Ataide, Holger Fritzsche, Prof. Dr. Michael Friebe
Förderer: Stiftungen - Sonstige - 01.01.2017 - 18.12.2020

Graduate school "Technology Innovations in Therapy and Imaging Graduate School"

The Technology Innovations in Therapy and Imaging Graduate School will foster the next generation of scientists in the field of innovative image guided therapies and interventions.
The aim of the program is to provide an intensive, research-oriented training in which the students acquire the knowledge in the fields of medicine, electrical engineering, physics, computer science, mathematics and other natural or engineering sciences, and to deepen and expand the skills in the field of Technology Innovations in Therapy and Imaging.
The main focus of the training is on minimally invasive therapy, image guided surgeries, catheter technologies, innovation generation, technical translation and transfer. The transfer of expertise includes the theoretical, methodological and experimental bases for scientific work and promotes the ability for practical, research and teaching-related fields of activity along with sound soft skill development.